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MIL-C-49285  
19 October 1989

MILITARY SPECIFICATION

CABLES, SPECIAL PURPOSE, ELECTRICAL, ALUMINUM FOIL SHIELDED PAIRS,  
TRIPLETS, OR QUADS

GENERAL SPECIFICATION FOR

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This document covers cables composed of polyester-backed aluminum foil shielded pair, triplet, and quad configurations.

1.2 Classification. Cables shall be as specified herein (see 6.2 and 6.5).

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS

FEDERAL

L-P-390	-	Plastic Molding and Extrusion Material, Polyethylene and Copolymers (Low, Medium, and High Density).
QQ-W-461	-	Wire, Steel, Carbon (Round, Bare, and Coated).

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MIL-I-631	-	Insulation, Electrical, Synthetic Resin Composition, Nonrigid.
MIL-C-12000	-	Cable, Cord, and Wire, Electric, Packaging of.
MIL-C-39012	-	Connector, Plug, Electrical, Coaxial, Radio Frequency, General Specification for.
MIL-C-39012/16	-	Connectors, Coaxial, Radio Frequency, (Series BNC (Cabled) - Pin Contact, Class 2).
MIL-I-45208	-	Inspection System Requirements.
MIL-P-47271	-	Paper, Insulating Electrical.
MIL-M-81531	-	Marking of Electrical Insulating Materials.

(See supplement 1 for list of associated specifications.)

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: US Army Communications-Electronics Command, ATTN: AMSEL-ED-TD, Fort Monmouth, NJ 07703, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.
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AMSC N/A

FSC 6145

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### STANDARDS

#### FEDERAL

FED-STD-228 - Cable and Wire, Insulated; Methods of Testing.

#### MILITARY

MIL-STD-104 - Limit for Electrical Insulation Color.  
MIL-STD-130 - Identification Marking of U.S. Military Property.  
MIL-STD-45662 - Calibration Systems Requirements.

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Naval Publications and Forms Center, (ATTN: NPODS), 5801 Tabor Avenue, Philadelphia, PA 19120-5099.)

2.1.2 Other Government documents, drawing, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

#### DEPARTMENT OF DEFENSE

Handbook H4-1 - Federal Supply Code for Manufacturers (Part 1).

(Applications for copies should be addressed to the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.)

2.2 Non-Government publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2).

#### AMERICAN SOCIETY FOR TESTING AND MATERIALS

ASTM B173 - Conductor, Copper, Rope Lay Stranded, Having Concentric Stranded Members, for Electrical Conductors.  
ASTM B174 - Standard Specification for Bunch-Stranded Copper Conductors for Electrical Conductors.  
ASTM B286 - Conductor, Copper, For Use in Hookup Wire for Electronic Equipment.  
ASTM D470 - Standard Methods of Testing, Crosslinked Insulations and Jackets for Wire and Cable.  
ASTM D2240 - Rubber Property - Durometer Hardness.  
ASTM D4101 - Specification for Propylene Plastic Injection and Extrusion Materials.

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

#### MUNSELL COLOR CHARTS FOR PLASTIC CABLE AND WIRE

(Application for copies should be addressed to the Munsell Color Company, Inc., 2441 N. Calvert Street, Baltimore, MD 21218.)

UNDERWRITER LABORATORIES

UL 1581 - Reference Standard for Electrical Wires, Cables, and Flexible Cords.

(Application for copies should be addressed to UL Publication Stock, 333 Pfingsten Road, Northbrook, IL 60062).

(Non-Government standards and other publications are normally available from the organizations that prepare or distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.3. Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related associated detail specifications, specification sheets, or MS standards), the text of this document shall take precedence. Nothing in this document, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Specification sheets. The individual item requirements shall be as specified herein and in accordance with the applicable specification sheets. In the event of any conflict between requirements of this specification and the specification sheet, the latter shall govern.

3.1.1 First article. When specified (see 6.2), a sample shall be subjected to first article inspection (see 6.3) in accordance with 4.3.

3.2 Materials. Materials shall be as specified herein. However, when a definite material is not specified, a material shall be used which will enable the cables to meet the performance requirements of this document.

3.2.1 Conductor material. Solid and stranded conductors are to be in accordance with ASTM B286, ASTM B173, or ASTM B174, except that the direction of the lay may be right or left. Drain wire is to be in accordance with ASTM B286, except that the direction of the lay may be right or left. Individual item construction and wire gauge will be specified in 3.1.

3.2.2 Conductor insulation. Polyvinyl chloride, polyethylene, and polypropylene materials used in the cable shall be in accordance with the following.

3.2.2.1 Insulated conductor. Conductors shall be insulated with polyvinyl chloride (PVC), polyethylene, or polypropylene as specified in 3.1. The insulation of the conductors shall be color coded as specified in table I.

3.2.2.2 Polyvinyl chloride (PVC). When specified (see 3.1), the insulation shall be polyvinyl chloride or its copolymer PVC, polyvinyl acetate, conforming to the requirements of the UL 1581 and the applicable specification sheet.

3.2.2.3 Polyethylene. Polyethylene shall conform to L-P-390, type II, class L, grade 3.

3.2.2.4 Polypropylene. Polypropylene shall conform to ASTM D4101.

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TABLE I. Color coding.

Pair number	Color coded	Pair number	Color coded
1	Black paired with Red	19	White paired with Blue
2	Black paired with White	20	White paired with Yellow
3	Black paired with Green	21	White paired with Brown
4	Black paired with Blue	22	White paired with Orange
5	Black paired with Yellow	23	Blue paired with Yellow
6	Black paired with Brown	24	Blue paired with Brown
7	Black paired with Orange	25	Blue paired with Orange
8	Red paired with White	26	Brown paired with Yellow
9	Red paired with Green	27	Brown paired with Orange
10	Red paired with Blue	28	Orange paired with Yellow
11	Red paired with Yellow	29	Purple paired with Orange
12	Red paired with Brown	30	Purple paired with Red
13	Red paired with Orange	31	Purple paired with White
14	Green paired with White	32	Purple paired with Dark Green
15	Green paired with Blue	33	Purple paired with Light Blue
16	Green paired with Yellow	34	Purple paired with Yellow
17	Green paired with Brown	35	Purple paired with Brown
18	Green paired with Orange	36	Purple paired with Black
		37	Gray paired with White

3.2.3 Binders, separators, and fillers. Unless otherwise specified (see 3.1), the materials shall be in accordance with 3.2.3.1 through 3.2.3.5, and shall be nonconductive. The materials may be utilized as processing aids and identification markers in constructing the cable.

3.2.3.1 Polyester tape. Tape shall conform to type G of MIL-I-631.

3.2.3.2 Paper tape. Tape shall conform to grade A, class 1, MIL-P-47271.

3.2.3.3 Polypropylene tape. Tape shall conform to ASTM D4101.

3.2.3.4 Fibrous fillers. Fibrous fillers shall consist of either cotton, jute, synthetic fibers, or glass fibers. The material selected shall be appropriate for the type of cable in which it is used and shall have been treated for flame or moisture resistance, or a combination of both, as necessary, to enable the cable to meet the requirements for the particular type of construction.

3.2.3.5 Nonfibrous fillers. Nonfibrous fillers shall consist of elastomeric material which is readily removable from insulation of conductors and insulating tapes over shields without the aid of solvents, cleaners, or tools. The acceptability of the material shall be determined by the cable filler removability test (see 3.4.16). Fillers shall show no signs of deterioration from aging stability for cold bend tests.

3.2.4 Jacket. The jacket material shall be as specified (see 3.1). The material may be extruded over cable pairs or over the barrier tape. Coloring shall be gray (slate), unless otherwise specified (see 3.1).

3.2.5 Shields. A shield with a minimum aluminum foil thickness of 0.00031 inch shall be bonded to a polyester tape with a minimum thickness of 0.00045 inch. If desired, an additional insulating polyester tape may be spirally wrapped over the shield. The color code of the shield shall be specified in accordance with item description in 3.1. Shielded electrical requirements are specified in 3.1. The unfolded foil shield width shall be consistent and shall vary not more than 0.030 inch throughout the manufactured lots.

3.3 Design and construction. The pairs, triplets, or quads shall be twisted with lays chosen to meet the applicable crosstalk requirements. The cable shall be assembled from the twisted pairs, triplets, or quads to form a substantially cylindrical core and jacketed overall. Cable length (see 3.1.1) shall be as specified in the contract or acquisition document (see 6.2.d).

3.3.1 Cable components.

3.3.1.1 Insulated copper conductors. The insulated copper conductors shall be in accordance with the military specification sheets (see 3.1) and the requirements stated herein.

3.3.1.2 Copper coated steel conductors. Copper coated steel conductors shall conform to QQ-W-461.

3.3.1.3 Drain wire. Drain wires shall be uninsulated stranded or solid, tin-plated conductors. Each strand shall be free from lumps, kinks, splits, scrapes, and corrosion. Splices made in conductors may be either brazed, using a silver alloy solder and a nonacid flux, or welded. Splices shall be butted and shall be free from lumps and sharp projections and also as specified in 3.2.1. In no case shall all strands of a multiple stranded conductor be spliced at one point along the conductor length. The tensile strength of any section of a conductor splice which was brazed or welded shall be not less than 85 percent of the tensile strength of adjacent sections without a splice. The lay of the drain wire shall be applied with the same lay as the conductors and shall have a common axis. The conductors shall maintain their relative position throughout the length of the cable. The individual drain wire configuration shall be as specified in 3.1.

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3.3.1.4 Shields. (See 3.1 and 3.2.5).

3.3.1.5 Jacket. The jacket shall be as specified in 3.2.4.

3.3.1.5.1 Polyvinyl chloride (PVC). (Jacket material only). The polyvinyl chloride shall be as specified in 3.2.2.2.

3.3.1.5.2 Polyethylene (PE). (Jacket material). The polyethylene shall conform to L-P-390, type III, class L, grade 3.

3.3.1.5.3 Crosslinked polyolefin. The crosslinked polyolefin shall meet the applicable requirements of the individual specification sheet (see 3.1) and as specified herein.

3.3.2 Twisting of pairs, triplets, or quads. The shielded pairs, triplets, or quads, shall consist of two, three, or four insulated wires and one drain wire. The pair lay length shall be selected in order to meet the applicable crosstalk requirements (see 3.4.6).

3.3.2.1 Cabling. The method by which a group of pairs, triplets, or quads is assembled shall be such that pairs, triplets, or quads are adjacent throughout the cable. Adjacent pairs, triplets, or quads shall exhibit the same configuration from one cabled end to the other end in any cable length. The pair, triplet, or quad configuration identification by shield color code and cable lay length shall be specified for each item in the corresponding specification sheets (see 3.1).

3.3.3 Patching. There shall be no patching on the insulation or the jacket material.

3.3.4 Cable, put-up. Cable shall be put-upon spools/reels unless otherwise specified in the acquisition document (see 6.2).

3.4 Performance.

3.4.1 Color, conformance. The jacket and insulation color shall correspond to class 1 of MIL-STD-104 (see 4.5.2).

3.4.2 Durometer hardness. The cable jacket material shall have a "Shore A" hardness as specified in 3.1 (see 4.5.3).

3.4.3 Tensile strength. The cable jacket shall have a minimum tensile strength as specified in 3.1 (see 4.5.4).

3.4.4 Elongation. The cable jacket shall have a minimum elongation as specified in 3.1 (see 4.5.5).

3.4.5 Jacket thickness and outside cable diameter. The jacket thickness and outside cable diameter shall be as specified in 3.1. The minimum spot thickness of the jacket shall be not less than 70 percent of the specified thickness and the average thickness of any cross section of the jacket shall be not less than 90 percent of the specified thickness (see 4.5.6).

3.4.6 Crosstalk. The crosstalk between two adjacent shielded pairs of the cable shall be as specified in 3.1. Crosstalk testing is not required on single pair cables (see 4.5.7).

3.4.7 Shield continuity and insulation resistance. The resistance between the shield and its drain wire shall be less than 1 ohm. The resistance between all other components shall be greater than 200 megohms per thousand feet at 500 V dc (see 4.5.8), unless otherwise specified (see 3.1).

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3.4.8 Copper conductor resistance. The direct current, dc resistance, shall be as specified in table II. Test sample readings shall be ohms per 1,000 feet length (see 4.5.9).

TABLE II. DC resistance.

A Wire table AWG	B Limit, ohms/1,000 feet 68° F (20° C)
16	5.4 maximum
18	7.3 maximum
20	11.7 maximum
22	18.5 maximum
24	29.7 maximum

3.4.9 Aging stability. There shall be no evidence of cracks or flaws in either the insulation material, the jacket, or the fillers (see 4.5.10).

3.4.10 Dielectric withstanding voltage. In each length of completed cable, the insulation between conductors, between conductors and shield, and between adjacent shields shall withstand the dc potential for three seconds as follows (see 4.5.11):

DC volts minimum

Between conductors	3,600
Between conductors and shield	1,800
Between shields of two adjacent pairs	600

3.4.11 Cold bend. There shall be no evidence of cracks or flaws in either the insulation, jacket material, or fillers. The markings shall be legible (see 4.5.12).

3.4.12 Dielectric reeling. The cable shall meet the dielectric withstanding voltage test of 3.4.10 between the shields after repeated unreeling in accordance with 4.5.13. Any failure within the cable shall be cause for rejection.

3.4.13 Shield coverage. There shall be no breaks in the shield covering (see 4.5.14).

3.4.14 Flex test. The cable shall be tested in accordance with 4.5.15. Following the flex test, the cable shall meet the crosstalk requirements as specified in 3.4.6.

3.4.15 Shield integrity test. Each shield when tested shall meet the requirements as specified in 3.1 (see 4.5.16).

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3.4.16 Cable filler removability. The filler material shall be flexible and shall be removable from any part with which it is in contact, through the use of fingers only. It shall not adhere to the fingers, to the insulation or to tape or other coverings over shields. The presence of occasional particles or slivers of filler residue will be acceptable, providing that these can be removed by light brushing with the fingers. Filler material which leaves residue that is removable only by vigorous wiping or through the use of solvents will not be acceptable (see 4.5.17).

3.4.17 Flammability. The cable shall meet the requirements as specified in 3.1 (see 4.5.18).

3.5 Cable identification. Unless otherwise specified (see 3.1), cables shall be marked with the military part number (see 3.1 and 1.2.1), manufacturer's code symbol and name, and any applicable UL printing requirements associated with the UL style called out in the specification sheet. Printing shall be located on the outside of the jacket in accordance with the basic requirements of MIL-STD-130. The marking shall be done in such a manner as not to deform or otherwise damage the jacket or outer covering. The first 25 feet of the cable sample unit shall be examined for the marking requirements. The marking shall be visible and legible from the outside of the cable. The marking shall be legible after the aging stability and cold bend tests. Marking is to appear throughout the entire length of the cable and is not to exceed 24 inches in marking interval.

3.5.1 Cable identification permanency and durability. Marking shall conform to the requirements of MIL-M-81531.

3.6 Workmanship. Cables shall be processed in such a manner as to be free from all defects which could affect proper functioning in service. The exterior surfaces shall be smooth, uniform, and free from splinters and other defects visible to the naked eye.

#### 4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in this specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items shall meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

4.1.2 Inspection and quality control system. The supplier shall have an inspection system and quality control system in accordance with MIL-I-45208.



4.1.3 Test equipment and inspection facilities. Test and measuring equipment and inspection facilities of sufficient accuracy, quality, and quantity to permit performance of the required inspection shall be established and maintained by the supplier. The supplier shall establish calibration of inspection equipment to the satisfaction of the Government. Calibration of the standards which control the accuracy of inspection equipment shall comply with the requirements of MIL-STD-45662.

4.2 Classification of inspection. The inspections specified herein are classified as follows:

- a. First article inspection on completed cables (see 4.3).
- b. Quality conformance inspection (see 4.4).
  - (1) Quality conformance inspection on individual conductors.
  - (2) Quality conformance.

4.3 First article inspection. Unless otherwise specified (see 6.3), first article samples shall be fabricated and tested by the manufacturer with tools and methods that, as far as practicable, are the same as those which will be used for quantity production of the product. The manufacture of the cable for a Government contract, prior to approval of the first article sample, shall be at the manufacturer's risk. First article inspection shall be performed on suitable length of cable. Certification of compliance for the basic material may be obtained from the supplier of the material providing that such certification contains actual tests, examination, or other verifiable quality data. First article inspection test reports shall be forwarded to the acquiring activity, unless otherwise specified (see 6.2), for approval.

4.3.1 Samples. Three first article samples shall be subjected to the tests listed in table III. No failures shall be permitted.

4.4 Quality conformance inspection. Quality conformance inspection shall consist of the tests specified in 4.4.1 and 4.4.2.

4.4.1 Quality conformance inspection on individual conductors. The insulated conductor shall be inspected prior to cabling. Both solid and stranded insulated conductors shall be inspected to, and in accordance with 3.3.1.1.

4.4.2 Quality conformance inspection on completed cables. Quality conformance inspection on completed cables shall be in accordance with groups A and B tests (see 4.4.3 and 4.4.4).

4.4.2.1 Inspection lot. All cables of the same number of pairs, triplets, or quads, offered for delivery at one time shall be considered a lot for purposes of sampling and inspection. Quantities of cables which might be delivered against two or more contracts may be combined into one lot for purposes of sampling if produced at the same time.

4.4.2.2 Unit of product. The unit of product for determining lot size shall be the number of spools/reels of cables having the same number of pairs, triplets, or quads, and the same approximate manufactured length.

4.4.2.2.1 Sample. The sample shall consist of that number of units of product required by the sampling plan for the lot size determined in 4.4.2.1.

4.4.2.2.2 Specimen. A specimen is a length of completed cable from one unit of product.

TABLE III. First article inspection.

Inspection	Requirement paragraph	Test paragraph
Visual and dimensional examination	3.2, 3.3, 3.5, and 3.6	4.5.1
Color conformance	3.4.1	4.5.2
Durometer hardness	3.4.2	4.5.3
Tensile strength	3.4.3	4.5.4
Elongation	3.4.4	4.5.5
Jacket thickness and outside cable diameter	3.4.5	4.5.6
Crosstalk	3.4.6	4.5.7
Shield continuity and insulation resistance	3.4.7	4.5.8
Conductor resistance	3.4.8	4.5.9
Aging stability	3.4.9	4.5.10
Dielectric withstanding voltage	3.4.10	4.5.11
Cold bend	3.4.11	4.5.12
Dielectric reeling	3.4.12	4.5.13
Shield coverage	3.4.13	4.5.14
Flex test	3.4.14	4.5.15
Shield integrity test	3.4.15	4.5.16
Cable filler removability test	3.4.16	4.5.17
Flammability	3.4.17	4.5.18
Marking durability test	3.5.1	4.5.19

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4.4.3 Group A inspection. Group A inspection shall consist of the examination and tests shown in table IV.

4.4.3.1 Sampling for group A, subgroup 1. The tests prescribed in table IV, subgroup 1, shall be performed on every length of finished cable. If any sample fails in any test, the entire length of cable shall be rejected. Samples on the adjacent reels shall be subjected to the same test in which failure occurred.

4.4.3.2 Sampling for group A, subgroup 2. Unless otherwise specified, samples shall be selected in accordance with table V for subgroup 2 inspection of table IV. Within each specimen of the sample, the insulated conductors shall be selected in accordance with table VI.

4.4.3.3 Sampling for measurement of colors. In each specimen (see 4.4.3.2), pairs shall be selected at random in accordance with table VI. The number of pairs on one end of the cable so examined shall be the same as specified in 4.4.3.2.

4.4.4 Group B inspection. Group B inspection shall consist of the test shown in table VII. Specimens shall be selected in accordance with table VIII. For the crosstalk test, the number of pairs within the specimen shall be selected in accordance with table IX and the test results shall be computed in accordance with table VII to determine acceptance.

4.4.5 Rejected lots. If an inspection lot is rejected, the supplier may withdraw the lot, rework it to correct the defects, or screen out the defective units; such lots shall be clearly identified as reinspected lots. Rejected lots shall be inspected using tightened inspection; the sample size shall be the sample shown in table V and table VIII for the next larger lot size for the applicable test.

4.4.6 Inspection of packaging. The sampling and inspection of the preservation, packing, and container marking shall be in accordance with the requirements of MIL-C-12000.

4.5 Methods of inspection.

4.5.1 Visual and dimensional examination. A 10-foot length of cable cut from the end of the specimen shall be examined to verify that the materials, design and construction, cable identifications, and workmanship are in accordance with the applicable requirements (see 3.2, 3.3, 3.5, 3.6). The cable shall be examined for jacket imperfections on all of the surface which is visible without unwinding the cable from the reel.

4.5.2 Color conformance (see 3.4.1). The insulation and jacket color shall be in accordance with the Munsell color chart for class 1 of MIL-STD-104 and shall match the preferred limits, unless otherwise approved by the contracting officer. If any pair is found not having color as specified, every pair in that specific length shall be compared with the Munsell color card. Also, the spools/reels of cable preceding and following shall be examined to determine the extent of incorrect coloring.

4.5.3 Durometer hardness (see 3.4.2). The cable jacket shall be tested in accordance with ASTM D2240 on a shore durometer, type A.

4.5.4 Tensile strength (see 3.4.3). The cable jacket shall be tested in accordance with method 3021 of FED-STD-228 or ASTM D470.

4.5.5 Elongation (see 3.4.4). The cable jacket shall be tested in accordance with method 3031 of FED-STD-228 or ASTM D470.

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TABLE IV. Group A inspection.

Inspection	Requirement paragraph	Test paragraph
<u>Subgroup I</u>		
Visual and dimensional examination	3.2, 3.3, 3.5, and 3.6	4.5.1
Cable filler removability	3.4.16	4.5.17
<u>Subgroup II</u>		
Color conformance	3.4.1	4.5.2
Durometer hardness	3.4.2	4.5.3
Tensile strength	3.4.3	4.5.4
Elongation	3.4.4	4.5.5
Jacket thickness and outside cable diameter	3.4.5	4.5.6
Shield continuity and insulation resistance	3.4.7	4.5.8
Conductor resistance	3.4.8	4.5.9
Dielectric withstanding voltage	3.4.10	4.5.11
Dielectric reeling	3.4.12	4.5.13
Shield coverage	3.4.13	4.5.14
Cable identification permanency and durability	3.5.1	4.5.18

TABLE V. Sampling for group A, subgroup II inspection.

Lot size, number of units (reels) of cable	Sample units to be inspected	Acceptance number	Maximum failures allowed per sample
1 to 13	2	2	0
14 to 25	3	3	0
26 to 62	4	4	0
63 to 160	7	7	0
161 to 410	10	9	1

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TABLE VI. Sampling for group A, subgroup 2.

Pairs in cable	Pairs to be tested
3	3
6	6
9	7
11	7
15, 16	8
19	9
26	10
27	10
52	15
104	20

TABLE VII. Group B inspection.

Inspection	Requirement paragraph	Test paragraph
Crosstalk	3.4.6	4.5.7
Flex test	3.4.14	4.5.15
Shield integrity	3.4.15	4.5.16

TABLE VIII. Sampling for Group B inspection.

Lot size, number of units (spools/reels) of cable	Number of specimens for tests required	Maximum specimen failures allowed
1 to 17	3	0
18 to 35	4	0
36 to 70	5	0
71 to 140	7	0
141 to 280	10	1
281 to 560	14	1
561 to 1,120	20	2
1,121 to 2,240	28	3

TABLE IX. Pair sampling per specimen.

Number of pairs in specimen	Number of random pair combinations of crosstalk required	Maximum failures allowed per specimen <u>1/</u> and <u>2/</u>
104	20	2
52	15	2
27	10	1
19, 26	10	1
15, 16	8	1
11	6	0
9	5	0
6	3	0
3	2	0
2	1	0

1/ A failure is defined as a pair faulted to one or more adjacent pairs.

2/ A failure is also defined as a measurement not meeting the criteria as specified in 3.4.6.

4.5.6 Jacket thickness and outside cable diameter (see 3.4.5). The jacket thickness and outside cable diameter shall be measured with a micrometer caliper graduated to read in mils or 0.001 inch and having flat surfaces on both the anvil and end of the spindle, each approximately 0.25 inch in diameter. The surfaces of anvil and spindle shall be parallel to within 0.0001 inch.

4.5.6.1 Cables with filler. The jacket thickness and outside cable diameter shall be measured in accordance with method 1331 of FED-STD-228.

4.5.6.2 Cables without filler. A 2-foot length of cable shall be cut from the end of the specimen. The cable diameter shall be measured at two positions 12 inches apart along the sample length and three measurements 120 degrees apart around each position. The diameters shall be summed and then divided by 6 to obtain the average diameter. The jacket shall then be cut lengthwise in two places 180 degrees apart to obtain two equal sections. Three measurements of thickness shall be made on each piece 6 inches apart. The average thickness is the sum of these thicknesses divided by 6.

4.5.7 Crosstalk (see 3.4.6). Crosstalk shall be measured by applying a known signal voltage to a shielded pair. The voltage induced into an adjacent pair is then measured. Specimens shall be 150 feet in length. Cables shall be tested as follows:

- a. Crosstalk test: This test determines the balanced mode crosstalk between adjacent individual pairs within the cable. A known signal voltage shall be fed into a shielded pair and the voltage induced onto an adjacent pair is determined to be the crosstalk of the cable pair.
- b. For the purposes of this specification, crosstalk is defined as the difference (in dB) between the input level of the disturbing pair and the output level of a directly adjacent disturbed pair. The relationship between levels is to be relative to an impedance matched circuit - where signal source, receiver, and cable pairs are all properly terminated (both ends). The termination impedance shall be 50 ohms for all cables except those having expanded polyethylene dielectrics. These pair's termination impedance shall be 100 ohms (nominal).
- c. The applied signal level in the excited pair shall be +12 dBm. This level shall be maintained throughout the test.
- d. The cable specimen shall be tested while coiled on a reel. Both ends of the test sample must be made available.
- e. All shields of the cable under test shall be insulated from each other at the far end and shall be connected to the ground plane at the generator end.
- f. Equipment required, the equipment shall be capable of making measurements over the frequency ranges, and amplitude levels required. The equipment shall be sensitive enough to allow the detection of changes four times less in magnitude than those called for in 3.4.6.
- g. Both near end and far end crosstalk measurements are to be made. The results shall be as specified in 3.4.6.

4.5.8 Shield continuity and insulation resistance (see 3.4.7). Resistance between drain wire and shield, between conductors in pair, between each conductor and its shield, and between shields shall be measured with a suitable instrument having not less than 1 percent accuracy.

4.5.9 Conductor resistance (see 3.4.8). The resistance of each conductor shall be measured in accordance with method 6021 of FED-STD-228.

4.5.10 Aging stability (see 3.4.9). Unless otherwise specified (see 3.1.1), the cable shall meet the aging stability test. Specimens of the cable shall be duplicates of those specified in 4.5.12.1. The specimens shall be suspended in a test oven at the test temperature, without touching one another, or the walls of the oven. Heated air at atmospheric pressure shall be circulated so as to maintain a uniform temperature of  $98^{\circ}\text{C} \pm 2^{\circ}\text{C}$  in the oven. The specimens shall be conditioned for a period of 7 days. After this conditioning period, the specimens shall be removed from the oven and conditioned at room temperature for a minimum of 4 hours.

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4.5.11 Dielectric withstanding voltage (see 3.4.10). The cable shall be subjected to a dielectric withstanding test to determine conformance with 3.4.10. Points of application are as follows:

- a. Conductor to conductor.
- b. Conductor to shield/drain wire.
- c. Between shields/drain wire of adjacent pairs.

4.5.12 Cold bend (see 3.4.11).

4.5.12.1 Specimens. For cables with an overall diameter of less than 0.500 inch, the tests shall be conducted on three specimens of cable; the length of each specimen shall be at least 150 times the diameter. For 0.500 inch and larger diameter cables, the tests shall be conducted on two specimens of cable; the length of each specimen shall be at least 120 times the diameter of the cable.

4.5.12.2 Procedure. One end of the test specimen shall be clamped circumferentially at two points, approximately 45 degrees apart, to a mandrel whose diameter is 10 times that of the test specimen. The specimen shall be wrapped around the mandrel for one full turn. The mounted specimen shall then be conditioned for 20 hours at a temperature of  $-20^{\circ}\text{C} \pm 2^{\circ}\text{C}$ . During this conditioning period, the specimens shall be kept reasonably straight. After this conditioning, but while the specimens are still in the cold chamber at the conditioning temperature, the specimens shall be wrapped for three close turns (two close turns for cables having a diameter of 0.500 inch and greater) around the mandrel at a uniform rate of  $15 \pm 3$  revolutions per minute, preferably by means of an electrically-driven motor. The cable shall be guided by a free moving sheave or transversing device in intimate contact with the cable at the initial point of bend. The cable shall then be removed from the cold chamber and visually examined except at clamping points. The specimen shall then be tested in accordance with 4.5.11.

4.5.13 Dielectric reeling (see 3.4.12). Unless otherwise specified in 3.1, one sample from each lot (approximately 500 feet) of finished cable shall be rewound from one reel to another for a total of five times. There shall be sufficient tension to cause the cable to remain in full contact with the reels. The dielectric withstanding voltage test between all shields/ drain wires of adjacent pairs shall then be performed in accordance with 4.5.11, from each drain wire/shield in turn to all other drain wires/shields.

4.5.14 Shield coverage (see 3.4.13). A foil shielded pair of sufficient length shall be coiled around a mandrel. The mandrel shall be three times the diameter of the shielded pair. The sample must remain in full contact with the mandrel.

4.5.15 Flex test (see 3.4.14). The cable shall be laid on a flat surface with two feet of the cable extending over the edge. Bend the sample over the edge 90 degrees, straighten and repeat 25 times. Rotate the sample 45 degrees and repeat the flexing another 25 times. The bend radius is to be 10 times the cable diameter. The same sample as used in 4.5.7 shall be used in this test.

4.5.15.1 Crosstalk. Repeat the crosstalk test as in 4.5.7. Results shall meet the crosstalk requirements stated in 3.4.6.

4.5.16 Shield integrity test (see 3.4.15).

NOTE: See appendix A for description of the test fixture.



#### 4.5.16.1 Sample preparation.

4.5.16.1.1 Jacket removal. Single and dual pair cables shall be tested with their jackets in place unless otherwise specified in the individual specification sheet. Multipair cables shall have the jackets removed. Carefully score not quite through the jacket and tear the jacket away, being careful not to cut or disturb the configuration of the shield. Remove a 38-inch long sample pair from the cable under test, again being careful not to disturb the configuration. Nothing other than the plastic holder included with the test fixture shall be used to preserve the physical arrangement of the shield structure during the test, except at the ends of the sample where a small piece of tape may be used to prevent unwinding of the shield at the termination.

4.5.16.1.2 Sample assembly. The sample assembly is to be 36 inches long over the mating faces of the modified BNC connectors (see figure 1). The BNC connectors are type M-39012/16 in accordance with MIL-C-39012. The three washers normally used in the connectors are discarded. A 1.25-inch length of 0.187" OD copper tubing is soldered into the retaining nut with 1 inch extruding outward. All flux must be removed from the threads of the retaining nut and connector body following this and any subsequent soldering operations, as anything preventing good metal to metal contact in the threaded joint may result in a false indication of failure.

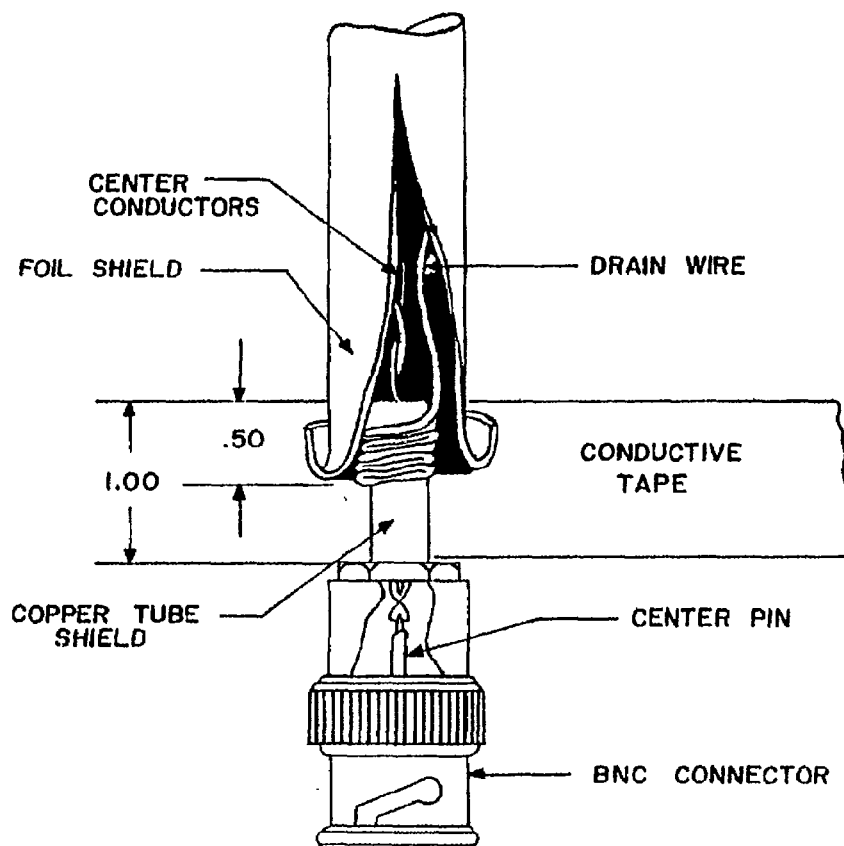
Approximately 1.5 inches of shield is to be carefully unwrapped from each end of the sample (one end will probably have to be slit longitudinally) and folded back. Both insulated conductors are to be end stripped and soldered together into the BNC connector center pin. Any exposed conductor at the base of the pin is to be covered with a small piece of electrical tape to prevent shorting to the connector shell or copper tube. The pin and conductors are then inserted through the copper tube and the pin is seated in the connector.

Samples having inward facing foil shall have the drain wire wrapped around the copper tube and soldered to it. One half inch of the shield foil shall be folded to face outward (see figure 1) and the assembly shall be wrapped with .003" copper foil tape (which may have conductive pressure-sensitive adhesive). The tape shall extend from just beyond the connector retaining nut past any opening in the shield. It shall be pressed firmly around the copper tube, the exposed folded back portion of the shield foil and the shield beyond any disturbed area. The copper foil shall be soldered to the copper tube and all seams or cracks in the copper foil shall be soldered shut. Care must be taken to avoid melting insulation on the conductors. Connectors shall be attached to both ends of the sample in the above manner and the assembly shall be tested for shorts between the center pin and shell using an ohmmeter or other low voltage method.

A shielded 50 ohm coaxial load having a BNC connector shall be attached to one end of the sample. The sample shall be placed in the plastic support tube and suitable insulation shall be placed over the coaxial load so it will not short to the inner tube of the fixture. Care shall be taken not to disturb the shield configuration while inserting the sample into the support tube. Samples having outward facing shields shall be treated in the same manner except that one-half inch of the shield shall be folded inward for intimate contact with the copper tube.

Other methods of sample assembly are acceptable provided they achieve the same goals. Any RF leakage at the sample ends will contribute to sample failure.

4.5.16.1.3 Sample installation. Attach the specimen to the BNC feed through inside the cover plate. Guide the specimen into the inner tube of the fixture, close the fixture and tightly secure the flanges. Wing nuts may be used instead of hex nuts for convenience.



NOTES:

1. BNC is standard type with 0.187 inches copper tubing soldered into the retaining nut, 1.25 inches of tubing should be used.
2. The BNC connector is modified to include a copper tube to shield connections.

FIGURE 1. Connector installation.

4.5.17 Cable filler removability test. This test is applicable to the non-fibrous filler material used to fill voids or act as the cable core.

4.5.17.1 Specimens. A specimen shall consist of a length of completed cable approximately 10 feet long.

4.5.17.2 Procedure. All overall cable parts such as the jacket and/or binder tapes shall be removed from one end of the specimen so as to expose the pairs and filler material for a distance of about three feet. Without the use of tools, the filler shall be separated from the conductors or shielded pairs for their exposed length.

4.5.18 Flammability. The cable shall be tested in accordance with UL 1581.

4.5.19 Marking durability test. Test in accordance with MIL-M-81531.

## 5. PACKAGING

5.1 Packaging requirements. Unless otherwise specified in the contract or purchase order (see 6.2), packaging shall be in accordance with MIL-C-12000.

## 6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. These cables are intended to be used as audio, control, data, and instrumentation cables in protective buildings and shelters. Use may include flexing, requirements include low dielectric constant. Temperature range is -20°C to +80°C.

6.2 Acquisition requirements. Acquisition documents should specify the following.

- a. Title, number, and date of this specification.
- b. Issue of DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1).
- c. Part or Identifying Number (PIN) (see 6.5).
- d. Title, number, and date of corresponding specification sheet (see 3.1).
- e. Number of first article samples, if other than specified in 4.3.1.
- f. Cable length if different from 3.1.1 (see 3.3).
- g. Other applicable documents (see 2.1.1).
- h. Packaging, preservation, and packing if other than section 5.

6.2.2 Contract data requirements. Data generated by this document is not deliverable unless specified on the Contract Data Requirements List (DD Form 1423). The data required by this document includes, but is not restricted to, the following:

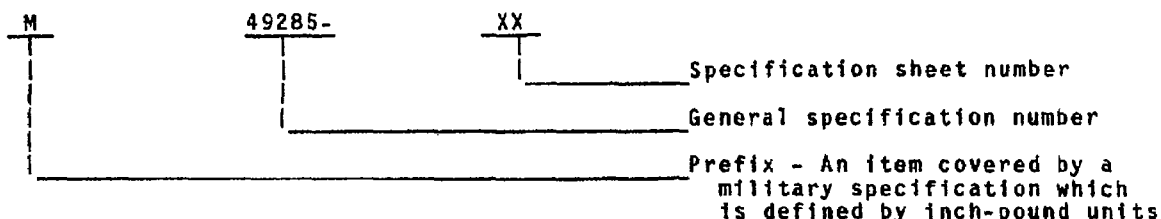
- a. Inspection and quality control system (see 4.1.1).
- b. Test equipment and inspection facilities (see 4.1.2).

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6.3 First article. Invitations for bids should provide that the Government reserves the right to waive the requirement for first article samples as to those bidders offering a product which has been previously acquired or tested by the Government, and that bidders offering such products who wish to rely on such production or test, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending acquisition.

6.4 Environmental pollution prevention measures. Environmental pollution prevention measures are contained in the packaging material specifications referenced herein. Refer to material specifications or preparing activity for recommended disposability methods.

6.5 Part or Identifying Number (PIN). The PIN to be used for cables acquired to this specification are created as follows:



## 6.6 Cross reference.

Former purchase description designator	Current basic cable specification designator
CR-CS-0099-000 Rev. B	MIL-C-49285
CR-CS-0099-001 Rev. C	MIL-C-49285/1
CR-CS-0099-002	MIL-C-49285/2
CR-CS-0099-003 Rev. D	MIL-C-49285/3
CR-CS-0099-004	MIL-C-49285/4
CR-CS-0099-005	MIL-C-49285/5
CR-CS-0099-006	MIL-C-49285/6
CR-CS-0099-007 Rev. A	MIL-C-49285/7
CR-CS-0099-008	MIL-C-49285/8
CR-CS-0099-009	MIL-C-49285/9
CR-CS-0099-010	MIL-C-49285/10
CR-CS-0099-011	MIL-C-49285/11
CR-CS-0099-012	MIL-C-49285/12
CR-CS-0099-013 Rev. D	MIL-C-49285/13
CR-CS-0099-014	MIL-C-49285/14
CR-CS-0099-015	MIL-C-49285/15

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6.6 Cross reference - Continued.

Former purchase description designator	Current basic cable specification designator
CR-CS-0099-016	MIL-C-49285/16
CR-CS-0099-017	MIL-C-49285/17
CR-CS-0099-018	MIL-C-49285/18
CR-CS-0099-019	MIL-C-49285/19
CR-CS-0099-020	MIL-C-49285/20
CR-CS-0099-021	MIL-C-49285/21
CR-CS-0099-022 Rev. C	MIL-C-49285/22
CR-CS-0099-023	MIL-C-49285/23
CR-CS-0099-024	MIL-C-49285/24
CR-CS-0099-025	MIL-C-49285/25
CR-CS-0099-026	MIL-C-49285/26
CR-CS-0099-027	MIL-C-49285/27
CR-CS-0099-028	MIL-C-49285/28
CR-CS-0099-029	MIL-C-49285/29
CR-CS-0099-030	MIL-C-49285/30
CR-CS-0099-031	MIL-C-49285/31
CR-CS-0099-032	MIL-C-49285/32
CR-CS-0099-033	MIL-C-49285/33
CR-CS-0099-034	MIL-C-49285/34
CR-CS-0099-035	MIL-C-49285/35
CR-CS-0099-036	MIL-C-49285/36
CR-CS-0099-037 Rev. A	MIL-C-49285/37
CR-CS-0099-038	MIL-C-49285/38
CR-CS-0099-045	MIL-C-49285/45

6.7 Subject term (keyword) listing.

Aluminum foil  
Crosstalk  
Drain wire  
Shield integrity

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APPENDIX A

SHIELD INTEGRITY TEST FIXTURE ASSEMBLY  
DESCRIPTION

10. SCOPE

10.1 Scope. This appendix details the assembly description for the shield integrity test fixture. This appendix is a mandatory part of this specification.

20. APPLICABLE DOCUMENTS

20.1 Non-Government publications.

IPCEA 5-69-530 - NEMA WC 41, Coaxial Communication Cable (ATV)

30. CONSTRUCTION

30.1 Assembly description. A cutaway drawing of the fixture is shown on figure 2. The outer conductor is the outer conductor of a 3 1/8-inch 50-ohm rigid coaxial transmission line with a flange on each end. The length over the flanges is 60 inches.

The inner conductor is the inner conductor of a 3 1/8-inch 50-ohm rigid coaxial transmission line, specified to be without centering pegs, not pierced. The overall length should be such that a 1/8-inch gap will exist between the end of the conductor and the inner surface of the end plate when the other end of the conductor is properly mated with the connector on the 3 1/8-inch to N adapter and this adapter is bolted to the outer conductor flange.

The inner conductor has a female banana jack in a rectangular mounting block brazed to its outer surface near the end next to the end plate (see figure 3, detail B). This mates with the center pin of the off-center connector in the end plate.

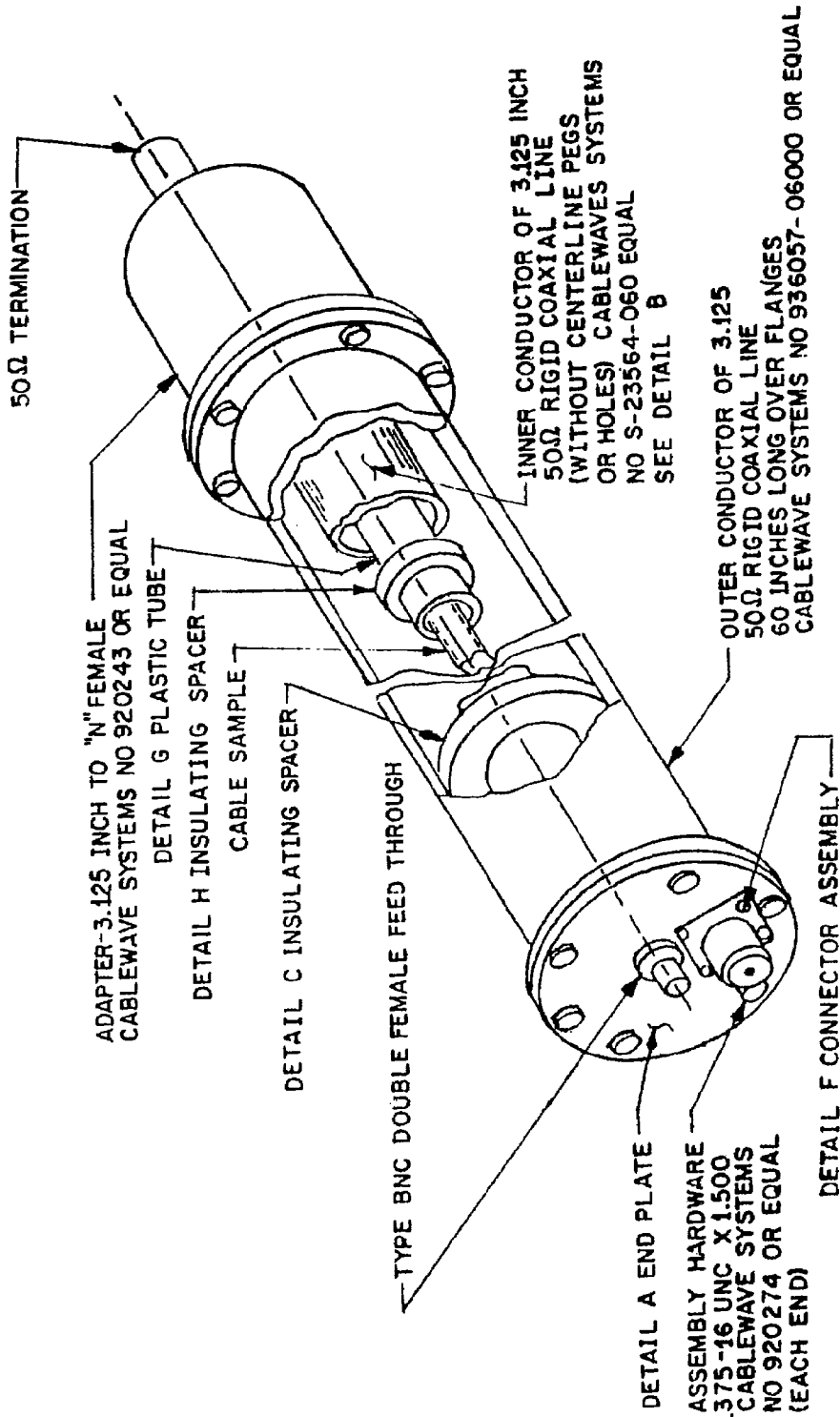
The inner conductor is supported near the end plate by means of a 3 1/8-inch connector insulator which has been modified by enlarging the center hole to form a press fit over the inner conductor and turning down the outside diameter to form a slip fit inside the outer conductor (see figure 3, detail C).

The end plate (see figure 3, detail A) is made from a 3 1/8-inch blank end plate having a 1/8-inch-thick center portion. A type BNC double female feed-through connector (UG-492A/U) is installed in the center of the end plate. A modified UG-58/U type N panel receptacle connector (see figure 3, detail D, E, and F) is installed off center in the end plate with the flange on the outside surface of the end plate (see figure 3, details A and F) to mate with the banana jack on the inner conductor.

The sample is to be prepared and terminated as specified in 4.5.16.1.

To assist in centering the sample being tested within the inner conductor tube, a polyethylene or acrylic plastic tube having an inside diameter slightly larger than the diameter of the sample and having a lengthwise slot slightly wider than the diameter of the sample shall be used (see figure 3, detail G). This plastic tube shall be centered by means of "C" shaped nylon washers which form a slip fit inside the inner conductor and a snug fit on the plastic tube (see figure 3, detail H).

Note: The fixture described in IPCEA 5-69-530, NEMA WC 41 (which has been rescinded) is considered equivalent and may be used. That fixture used a modified GR-874 connector instead of the modified type N connector in the end plate.



CABLE SAMPLE IS 36 INCHES OVER FACES OF  
MALE BNC CONNECTORS-TERMINATED IN  
SPECIFIED SHIELDED LOAD.

INNER TUBE SPACED .123 INCH FROM END  
PLATE BY SHORTENING END AWAY FROM  
ADAPTOR.

FIGURE 2. Shield integrity test fixture.

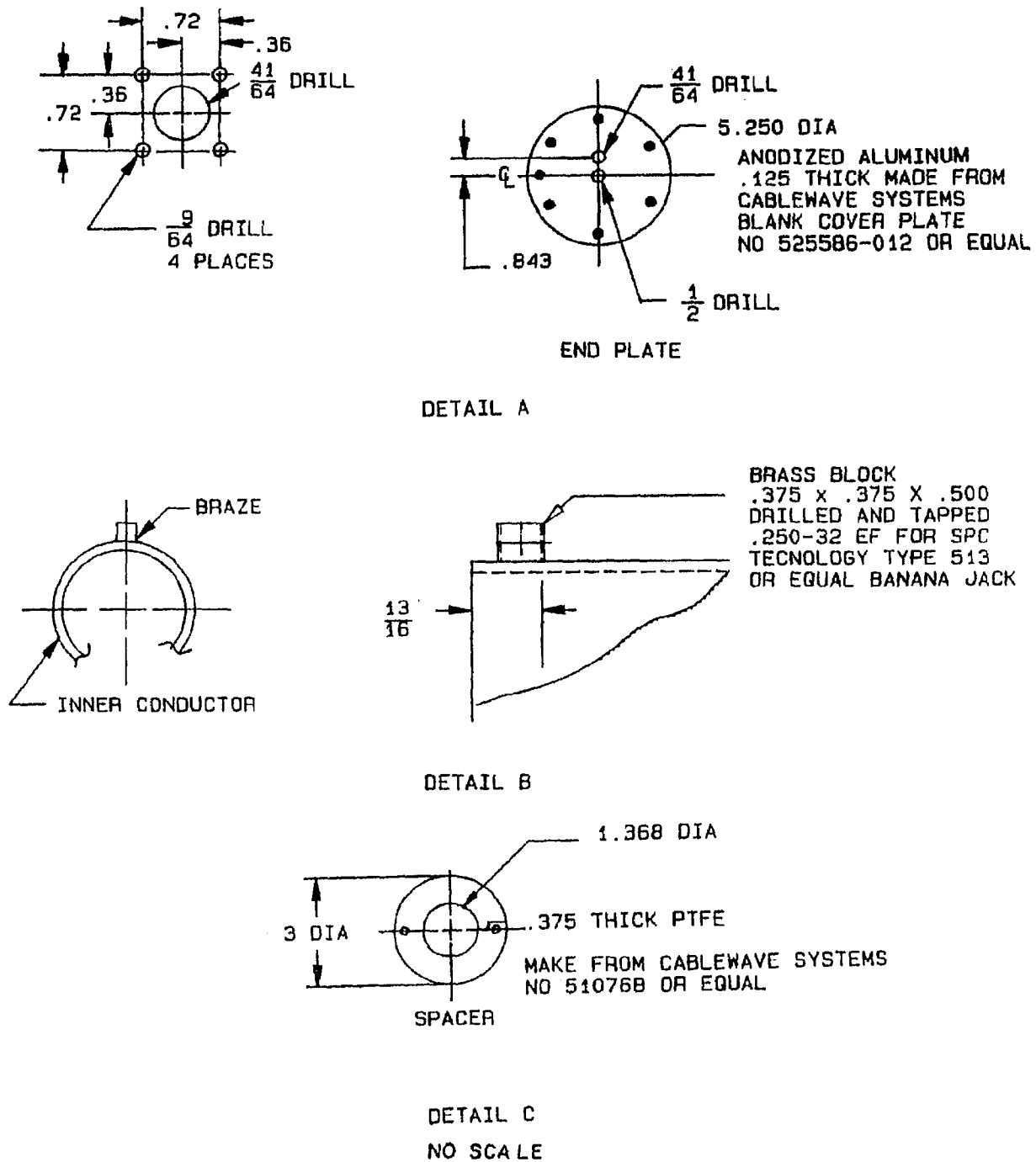
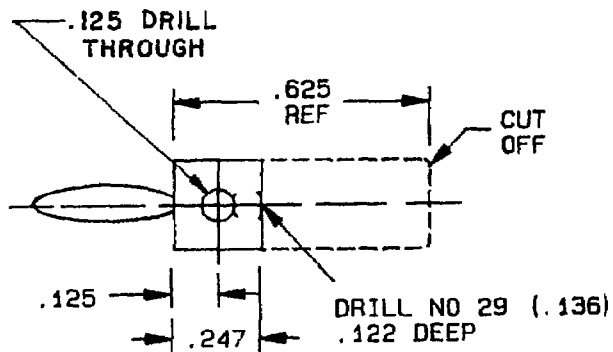


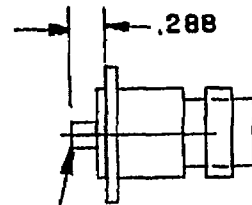
FIGURE 3. Shield integrity assembly components.





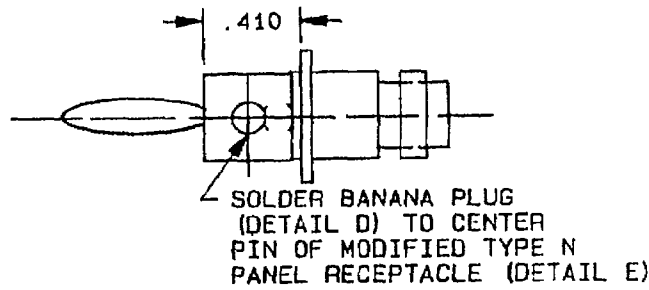
SPC TECHNOLOGY TYPE 852  
OR EQUAL BANANA PLUG-  
DISCARD PLASTIC SHELL  
AND SET SCREW-MODIFY AS  
AHOQN

DETAIL D

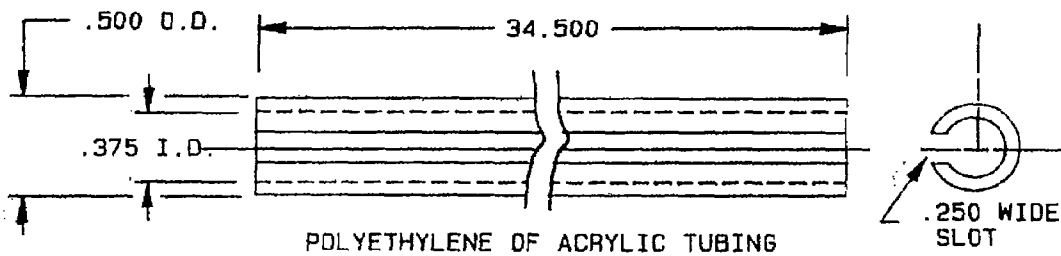


CUT BACK CENTER PIN  
OF UG-58/U TYPE N  
PANEL RECEPTACLE  
AMPHENOL 82-24 OR  
EQUAL

DETAIL E



DETAIL F

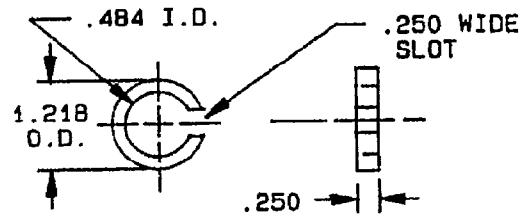


DETAIL G

NO SCALE

FIGURE 3. Shield integrity assembly components - Continued.

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NYLON-3 REQUIRED

DETAIL H

NO SCALE

Inches	mm	Inches	mm
.123	3.12	.484	12.29
.125	3.18	.500	12.70
.136	3.45	1.218	30.93
.250	6.35	1.500	38.10
.288	7.15	3.125	79.38
.375	9.53	34.500	876.30
.410	10.41		

NOTES:

1. Dimensions are in inches.
2. Metric equivalents for general information only.

FIGURE 3. Shield integrity assembly components - Continued.

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CONCLUDING MATERIAL

Custodians:

Army - CR  
Navy - SH  
Air Force - 85

Review activities:

Army - MI  
DLA - ES, IS

Preparing activity:

Army - CR

Agent:

DLA - ES

(Project 6145-1114)